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example, in any of an X-axis direction and a Y-axis direction. The spray nozzle pipe 18 discharges the spacers 20 together with the gas stream while inclining in a prescribed direction, whereby the spacers 20 can be sprayed out at a prescribed position of the glass substrate 16.

REMARKS

Favorable reconsideration of this application, in light of the present amendment of the specification and the following discussion requesting reconsideration of the rejections of the claims, is respectfully requested.

Claims 1-7 remain pending and unamended in this application.

In the outstanding Office Action, claims 2, 3, and 7 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite, and claims 1-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Doi et al.* in view of *Subramanian et al.*

Applicants wich to thank Examiner Michelle A. Lazor and Supervisory Examiner Richard Crispino for the courtesies extended to their representative, Attorney Gay Ann Spahn, during an interview conducted on April 16, 2003. During the interview, Attorney Spahn presented arguments in order to distinguish the present invention from the 35 U.S.C. § 103(a) rejection of claims 1-7 as being unpatentable over *Doi et al.* in view of *Subramanian et al.* as set forth in the Office Action.

Applicants have amended the specification in order to correct a minor typographical informality on page 7, line 7 by changing "splay" to --spray--. Applicants respectfully submit that the amendment to the specification does not add new matter.

Applicants respectfully traverse the rejection of claims 2, 3, and 7 under 35 U.S.C. § 112, second paragraph, as being indefinite for the following reasons.

The Office Action alleges that "[i]t is unclear how these claims further limit the claimed apparatus." Applicants respectfully submit that they do not believe it is unclear how the subject matter of claim 2, 3, and 7 further limit the subject matter defined in claim 1. More particularly, Applicants respectfully submit that claims 2 and 3 further define the density distribution which is the basis for the moving-speed control means to control the moving-speed of the tip of the spray nozzle pipe, and claim 7 further defines the member to be sprayed as a substrate of a liquid crystal display and the finely-divided spray powders as being spacers (i.e., particulate matter rather than liquid) which obviously make a difference with respect to the configuration of the apparatus and how the apparatus operates.

In addition, Applicants respectfully submit that the 35 U.S.C. § 112, second paragraph, rejection is improper because if the Office Action is trying to say that claims 2, 3, and 7 do not further limit the apparatus, then the rejection should be made under 35 U.S.C. § 112, fourth paragraph, and not 35 U.S.C. § 112, second paragraph.

Based on the foregoing, Applicants respectfully request withdrawal of the rejection of claims 2, 3, and 7 as being indefinite under 35 U.S.C. § 112, second paragraph.

Applicants respectfully traverse the rejection of claims 1-7 under 35 U.S.C. § 103(a) as being unpatentable over *Doi et al.* in view of *Subramanian et al.* because Applicants respectfully submit that one of ordinary skill in the art would not be motivated to combine *Doi et al.* with *Subramanian et al.* in the manner set forth in the Office Action since the two references are very different from each other so that one of ordinary skill in the art seeking to solve the problems solved by the present invention, would not look to the disclosure of *Subramanian et al.* for solutions to the problems. In fact, in ways, *Subramanian et al.* actually teaches away from *Doi et al.* as will be explained in more detail below.

First, as a quick synopsis of the applied prior art references, Applicants hereby refer to the abstracts of *Doi et al.* and *Subramanian et al.*, as follows.

Doi et al. disclose a finely-divided powder spray apparatus of the invention comprises a spray nozzle pipe disposed at a position spaced apart from a member to be sprayed a prescribed interval; a support unit of the spray nozzle pipe for supporting it so that it can be inclined; a first joint unit disposed to the upper end of the spray nozzle pipe; two linearly-moving actuators that each move in respective linear paths that are fixed relative to each other and each provided with a second joint unit; and two rods for coupling each of the second joint units with the first joint unit; wherein the finely-divided powder is sprayed onto the member to be sprayed from the spray nozzle pipe which is inclined in an arbitrary direction by combining the movements of the two linearly-moving actuators. This spray apparatus is a smaller apparatus capable of spraying the finely-divided powder such as liquid crystal spacers onto a larger member to be sprayed such as a larger glass substrate and does not uselessly spray finely-divided powder to the periphery of a member to be sprayed by providing a drive mechanism for driving a spray nozzle pipe which has a larger spray angle, can move in a prescribed direction at a high speed, applies a uniform load on drive sources for driving the spray nozzle pipe and can change the center of the locus of a spray path along which the finely-divided powder is sprayed and the moving speed of the center of the locus.

Subramanian et al. disclose a system and method is provided that facilitates the application of a uniform layer of developer material on a photoresist material layer. The system includes a multiple tip nozzle and a movement system that moves the nozzle to an operating position above a central region of a photoresist material layer located on a substrate, and applies a volume of developer as the nozzle scan moves across a predetermined path. The movement system moves the nozzle in two dimensions by

providing an arm that has a first arm member that is pivotable about a first rotational axis and a second arm member that is pivotable about a second rotational axis or is movable along a translational axis. The system also provides a measurement system that measures the thickness uniformity of the developed photoresist material layer disposed on a test wafer. The thickness uniformity data is used to reconfigure the predetermined path of the nozzle as the developer is applied. The thickness uniformity data can also be used to adjust the volume of developer applied along the path and/or the volume flow rate.

In the Summary of the Invention section of the present application, Applicants have described one of their problems to be solved, as follows:

> Recently, the side of a liquid crystal display panel has been increased gradually and a plurality of liquid crystal display panels have often been made of a single glass substrate, and it is therefore required to spray the spacers in a wider area. Thus, an increased swing angle has been required for the spray nozzle pipe to spray the spacers. Accordingly, a distance from the tip of the spray nozzle pipe to the substrate at the center of the substrate is increasingly different from that at the ends of the substrate, and **it is difficult to uniformly spray the spacers onto the larger glass substrate**. (Emphasis added).

Thus, it is clear that the present invention is concerned with substrate sizes that are getting larger and larger. However, in contrast, in the Background of the Invention section (see col. 1, lines 10-16), *Subramanian et al.* discloses, as follows:

> In the semiconductor industry, there is a continuing trend toward higher device densities. To achieve these high densities **there has been and continues to be efforts toward scaling down device dimensions (e.g., at submicron levels) on semiconductor wafers**. In order to accomplish such high device packing density, **smaller and smaller features sizes are required**. (Emphasis added).

Thus, it appears that *Subramanian et al.* is not dealing with increasing substrate sizes at all as the present invention is faced with, but rather the opposite (i.e., decreasing substrate sizes, in fact down to the submicronic level). This poses far different problems than the problems to be solved by the present invention so that Applicants respectfully submit that one

of ordinary skill in the art would not be motivated to look to *Subramanian et al.* for solutions to the problem of spraying larger and larger glass substrates. In fact, it would seem that *Subramanian et al.* actually teaches away from the present invention.

In addition, with respect to *Subramanian et al.*, Applicants respectfully submit that *Subramanian et al.* is very different from the present invention in the way that the coating is sprayed on the member to be sprayed and in the material that is being sprayed on the member to be sprayed and therefore, one of ordinary skill in the art would not be motivated to combine *Subramanian et al.* with *Doi et al.* in the manner set forth in the Office Action. More particularly, *Subramanian et al.* discloses an apparatus in which an arm (42) is held parallel to the member to be sprayed (i.e., wafer 52) and a liquid material is sprayed from a plurality of nozzle tips (41) as the arm (42) and nozzle (40) are moved over the surface of the wafer (52) as the wafer (52) is being spun on a rotating chuck (54) so that the liquid material is spin coated onto the wafer (52). In contrast, *Doi et al.* and the apparatus of the present invention employ a nozzle spray pipe (18) with a single nozzle tip which is located directly above a center of the member to be sprayed (i.e.; glass substrate 16) and which is swung at various angles to the X- and Y-directions in order to spray a particulate matter (i.e., spacers 20) onto a substrate mounted on a stationary table as is clearly shown in Fig. 1 of *Doi et al.* and the drawings of the present invention. Since *Subramanian et al.* is spraying liquid, rather than particulate matter as in *Doi et al.* and the present invention, and since *Subramanian et al.* is spraying with a plurality of nozzles held parallel to the wafer and swept over the wafer only once in a predetermined direction as the wafer is rotating on a spinning chuck so that the liquid is spin coated on the wafter, unlike *Doi et al.* and the present invention which uses only one nozzle tip spraying at an angle to the member to be sprayed which is mounted on a stationary table, *Subramanian et al.* hardly seems applicable to the present invention and

Applicants respectfully submit that one of ordinary skill in the art seeking to solve the problem of spraying larger and larger glass substrates would not be motivated to look to *Subramanian et al.* for a solution to the problem.

Further, *Subramanian et al.* discloses a system and method that facilitates the application of a uniform layer of liquid developer material on a photoresist material layer. In the last seven lines of the Abstract and in the Summary of the Invention section (see col. 3, lines 30-37), the system is described as including:

> . . . a measurement system that measures the thickness uniformity of the developed photoresist layer disposed on a test wafer. **The thickness uniformity data is used to reconfigure the predetermined path of the nozzle as the developer is applied. The thickness uniformity data can also be used to adjust the volume of developer applied along the path and/or the volume flow rate.** (Emphasis added).

Using thickness uniformity data to reconfigure the predetermined path of the nozzle and adjust the volume and/or volume flow rate of the liquid developer applied along the path as *Subramanian et al.* is doing is something quite different from what the present invention is doing in using a density distribution from a trial spray to control the moving speed of the tip of the spray nozzle pipe. Thickness is one-dimensional as being measured in any of meters or millimeters or microns, as the case may be with respect to *Subramanian et al.*, and thickness is sufficient in the application used in *Subramanian et al.* since a simple liquid developer is being sprayed (i.e., a liquid material being much easier to attain uniformity of coating than a particulate material).

In contrast, the present invention is measuring density, i.e., mass per unit volume. On page 1, lines 19-26, in the Background of the Invention section of the present invention, it is explained that:

> In the liquid crystal display panel of a liquid crystal display device and the like, particles (i.e., spacer beads such as plastic particles and silica particles) having a uniform particle size of about several microns to several

> tens of microns are sprayed or coated as spacers as uniformly as possible in an amount of 10 to 2000 particles per unit area of 1 mm2 to form a single layer between substrates . . . .

Thus, when it is spacers or particulate material that is being sprayed, it is much more difficult to get a uniform coating than when spraying a liquid material. As such, using thickness uniformity data as in *Subramanian et al.* is sufficient because liquid coating material is much easier to get a uniform coating than when using particulate material. In the present invention, Applicants found that it was necessary to use a density distribution to control the moving speed of the tip of the single spray nozzle pipe which is swept at an angle around a holding point in order to get the desired uniformity with respect to the spraying of particulate material.

Another difference between *Doi et al.* and *Subramanian et al.* resides in the fact that *Doi et al.* has no feed-back system for spray density (i.e., not real-time measurement). Instead, *Doi et al.* uses a trial spray in advance for spray density calibration, and makes determinations based upon the results (i.e., feed-forward). In contrast, in *Subramanian et al.*, the amount of spray is measured by a measurement system, and feed-back on the spray. Because of the obvious differences between the two systems of *Doi et al.* and *Subramanian et al.*, Applicants respectfully submit that one of ordinary skill in the are would not be motivated to combine the feed-forward system of *Doi et al.* with the feed-back system of *Subramanian et al.* because it would be like comparing apples and oranges (i.e., the two systems are just at such odds with one another that one of ordinary skill in the art would not think of combining them).

Thus, Applicants respectfully submit that one of ordinary skill in the art would not be motivated to combine *Doi et al.* with *Subramanian et al.* in the manner set forth in the Office

Action because the two references are just too different from each other and the two references go about solving different problems from each other in very different manners.

Based on the foregoing, Applicants respectfully request withdrawal of the rejection of claims 1-7 under U.S.C. § 103(a) as being unpatentable over *Doi et al.* in view of *Subramanian et al.*, and allowance of claims 1-7.

In view of the foregoing, claim 1-7 are believed to be in condition for allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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Marked-Up Copy
Serial No: 09/884,978
Amendment Filed on:
April 30, 2003

IN THE SPECIFICATION:

Please amend the specification, as follows:

Page 7, lines 7-19, please amend the paragraph, as follows:

A spray mechanism 22, having a [splay] spray nozzle pipe 18 for spraying the spacers 20, is disposed above the table 14. The spray nozzle pipe 18 discharges the spacers 20 transported through a flexible tube 24 together with a gas stream of air, a nitrogen gas, etc. and sprays the spacers 20 onto the glass substrate 16. The spray nozzle pipe 18 can be swung in an of prescribed first direction and second direction perpendicular to the first direction, for example, in any of an X-axis direction and a Y-axis direction. The spray nozzle pipe 18 discharges the spacers 20 together with the gas stream while inclining in a prescribed direction, whereby the spacers 20 can be sprayed out at a prescribed position of the glass substrate 16.